## Progress report for October, November, December, 1947: secret supplement

National Research Council of Canada. Electrical Engineering and Radio Branch


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LABORATORIES

OF

THE NATIONAL RESEARCH COUNCIL OF CANADA

ELECTRICAL ENGINEERING AND RADIO BRANCH



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Ottawa, January , 1948

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## COUNTER-BOMBARDMENT RADAR EQUIPMENT

Purpose. To locate mortars within any ten-degree sector out to a range of at least 5,000 yards. For applications such as locating the CB equipment with respect to the reference grid, road watching and location of shell bursts, the equipment will have a maximum range of 25,000 yards.

Method. The range and azimuth of two points on the trajectory of the mortar bomb are measured at known angles of elevation above an extrapolation plane, which may be coincident with the ground plane or inclined to it, as required by the terrain. Extrapolation of the two trajectory intercepts to this extrapolation plane then locates the position of the mortar. If the mortar location does not lie in this plane, a further correction for the elevation of the predicted position may be made.

Description. This radar operates on K-band and its display provides, on a five-inch cathode ray tube, a Type-B presentation, whose width represents 10 degrees of azimuth and whose height represents range. Sweep length under "search" conditions is continuously adjustable from 4,000 yards to maximum range. For accurate location, any 1,000-yard portion of range, within the range zero to 25,000 yards, may be expanded to cover the tube face. The horizontal scanning of the beam is produced by feeding an upper and lower horn alternately, by means of a rotating wave guide feed arm. The computer and the co-ordinate converter, together with the output information units, form the final part of the equipment. Dials and counters display radar and target locations in both polar and cartesian co-ordinates.

Status at end of September, 1947. The azimuth marker brightening and mixing circuits and the ranging and display circuits had been designed, built and tested, using full-size components. Because space and weight were at a premium, these circuits were later re-designed to utilize modern miniature components.

The azimuth sweep generator and the range and azimuth calibration circuits had been built and tested. Some work remains to be done on these units to adapt them to the use of miniature components.

A radio-frequency, high-voltage power supply, to furnish 10 kv for the cathode-ray display tube had been completed, and the laboratory

model has been in operation for nearly a year, with but one tube failure in that period.

A miniature goniometer, the heart of the ranging system, had been designed, built and tested. It replaced the cumbersome models commonly in use. The accuracy of the new unit, which is only 2 inches long by 1 1/4 inches in diameter, is higher than that of the goniometer previously employed. The latter was designed in 1943 for radar use and is about 7 inches long and 4 inches in diameter. A complete description of the goniometer is given in the non-secret portion of this progress report (ERA-149).

The triggering circuits for the modulator had been designed using large components, and have since been re-designed, using miniature components. Additional features, which permit interlaced firing of two similar modulators to improve the display quality, were covered in the last report, (ERA-144).

An experimental modulator had been built and used during the tests on the scanner and metal lens antenna assembly. The beam width produced by the twin-beam antenna was about 0.65 degrees in the horizontal plane and 0.9 degrees in the vertical plane. Detailed test results obtained on this completed assembly were also given in the above report.

The mechanical extrapolating computer, for locating the target position from the two trajectory intercepts, had been designed. The theory of its operation was covered in ERA-144 in some detail.

The co-ordinate converter had been designed and built and its mechanical operation checked. The operating panel mounting the output data gear boxes, had been assembled but not wired.

Modification of the Windsor carrier had been carried to the point where the antenna could be mounted and leveled.

Progress during Oct. - Dec. 1947. The Type-A scan was formerly a feature of the unit designated "Monitor A-Scope". It has been decided that more satisfactory performance could be expected as a result of a re-arrangement whereby the Type-A scan becomes a feature of the main display tube, which heretofore operated as a Type-B display only. The monitor tube, which is a three-inch cathode-ray tube, will be available as a monitor at all times, and will have independent sweep circuits, by means of which signals, or other wave forms, may be observed within any portion of the range. If desired, several cycles of either the range or azimuth wave forms may be observed.

Some of the advantages associated with the re-arrangement of the A-Scope are:

(1) The display size is increased as a result of the use of a five-inch tube. This results in an improvement in possible accuracy and ease of measurement.

(2) The Monitor is usable as such at all times and so may be used, if desired, as a continuous gauge of receiver performance.

(3) It is no longer necessary to have both tubes immediately in front of the operator.

The azimuth sweep condenser, referred to above, and described in more detail in ERA-144, has received considerable attention. A mathematical analysis of concentricity errors has been made, and as a result, a double stator-type has been designed to permit a lowering of mechanical tolerances. Some re-design has been applied to the associated electronic circuits to minimize distortion and increase the output. This work is not yet completed.

The mechanism by means of which the beam may be stopped at center scan is being constructed. Testing of the clutch, which is part of this mechanism, has resulted in the introduction of some refinements.

A number of the component parts of the extrapolating computer have been completed. Six differentials and the bi-directional, spring-return mechanism for resetting zero are now finished and the whole azimuth section will be assembled as soon as the mechanical integrators are available.

## MICROWAVE ZONE POSITION INDICATOR - MK II (MODIFIED A.A. NO. 4 MK 6)

Summary. As part of the program to increase the range of this equipment, an antenna of greater power-handling capacity was required. After successful tests of an experimental antenna had been made, the prototype antenna and hydraulic tilting mechanism was designed.

Progress. Detailed drawings of the hydraulic cylinder assembly have been completed. The oil pump, hyraulic accumulator, oil filter and various minor items are now on hand. The patterns for the ribs of the parabolic slice reflector have been received, and castings ordered. Experiments have been carried out to check the actual amount of spring-back, as compared with calculated values, for the material to be used for sheeting the antenna.

DISTRIBUTION

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